

## THE USE OF RADIO TRANSMITTERS TO TRACK SPECIFIC BONES OF SCAVENGED PIG CARCASSES

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### ABSTRACT

This is the first report on a pilot study using radio transmitter to track skeletal remains of scavenged pig carcasses. Three adult pigs were placed on property controlled by the Highlands Ranch Law Enforcement Training Facility in Douglas County, Colorado, from June to October 1994. Approximately eleven acres of this facility is designated for research conducted by NecroSearch International, a group of forensic scientists who conduct research with pig carcasses for the purpose of developing methods for locating clandestine graves. To simulate actual crime scenes, two pigs were placed in shallow graves while the third was left partially exposed in a drainage ditch. The three carcasses were instrumented with at least one radio transmitter. Following the burials, the radio transmitters allowed the researchers to monitor the movement of the instrumented bones to distances that, in one case, exceeded 400 meters from the burial site. Results from this study indicate that radio telemetry is an unexploited research tool that can effectively monitor the movement of certain skeletal remains during the process of scavenging.

**Keywords:** Forensic Science, Radio Telemetry, Wildlife Telemetry, Taphonomy, Radio Tracking, Scavenging, Carrion.

### RÉSUMÉ

Ceci est le premier rapport d'un projet-pilote utilisant des radio émetteurs afin de repérer les restes squelettiques de carcasses de porc pillées par des charognards. Trois porcs adultes furent placés sur une propriété appartenant au Highlands Ranch Law Enforcement Training Facility dans le comté de Douglas, Colorado pendant la période allant de juin à octobre 1994. Environ 11 acres de cette propriété sont réservées aux recherches du NecroSearch International, un groupe de chercheurs en science judiciaire qui travaillent avec des carcasses de porc pour développer une méthode de détection pour les tombes clandestines. Afin de simuler des scènes de crime, deux porcs furent placés dans des tombes peu profondes pendant qu'un troisième fut laissé partiellement à découvert dans une rigole d'assèchement. Les trois carcasses furent munies d'au moins un radio émetteur. Après l'enfouissement des carcasses, les radio émetteurs ont permis aux chercheurs de suivre à distance le mouvement des os, qui dans un cas furent retrouvés à plus de 400 mètres du site d'enfouissement. Les résultats de cette étude indiquent que la radio télémétrie est un outil de recherche sous-exploité qui peut servir à suivre le mouvement de certains restes squelettiques pendant le pillage de carcasse par les charognards.

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## INTRODUCTION

Thousands of hours are spent each year by law enforcement agencies in efforts to locate clandestine graves. However, limited research has been conducted to develop scientific methods and techniques to aid with these searches. Bodies deposited on the surface and in shallow graves are subject to a variety of natural disturbances including weather, erosion, scavenging, and vegetative cover. Of particular interest are the effects of animal scavengers since they can disperse a skeleton over a large area, often fragmenting the bones in the process (1,2). Several authors comment on the difficulties associated with the detection of scavenged remains (2-6). Haglund, et. al., (2) reports how differences in season, terrain, animal behavior, and human population densities can influence the degree of scavenging and disarticulation. Locating skeletal remains which have been dispersed over large areas is a necessary, although difficult, task for any law enforcement agency. Using radio transmitters to track selected skeletal remains may help to enrich the current body of knowledge regarding the taphonomic processes that can affect the osteological component of a site assemblage, namely, animal scavenging.

## METHODS

NecroSearch International, a non-profit organization comprised of interdisciplinary scientists, was formed in 1986 to conduct supportive research for the law enforcement community (5). Since 1987, NecroSearch has conducted research that involves the burying of pig carcasses on property operated by the Highlands Ranch Law Enforcement Training Facility in Douglas County, Colorado, for the purpose of studying controlled burial sites over extended periods of time. This activity is known as the P.I.G. ("Pigs-In-Ground") project, and modern scientific instruments are routinely used to monitor the changing conditions at these grave sites. A total of thirty-two sites are currently being studied under various burial and environmental conditions.

The P.I.G. site is located on eleven acres of open, uninhabited land. Upon initiation of the P.I.G. research project, animal scavengers were found to be scattering the pig carcasses over such a large area that some of the carcasses were lost. It was therefore decided to attach radio transmitters to selected bones of the carcass. After attachment, the transmitters were monitored on a weekly basis. The author employed a "Grid" ground search pattern using a portable receiver and antenna to receive the radio signal. These radio transmitters are similar to those used by wildlife biologists for tracking wild animals and operate in the VHF portion of the frequency spectrum, radiate a power of about 0.1 mW, weigh less than 15 g, and have an operating life of about one year. These transmitters make ideal monitoring devices since it is well known that animals can not detect the radio signals (7). We have also determined that the animals in the study area are not intrinsically attracted to the transmitters. As part of another study, active transmitters were left in the study area for a period of one year with absolutely no movement. The transmitters are attached around the carcass bones with a metal collar having a one-way clasp. All transmitters used for this study were supplied by the Denver Wildlife Research Center. The radio receivers used with these transmitters are specially designed to receive weak radio signals and are capable of detecting a minimum discernable signal at -145 dBm (decibels in milliwatts). The effective reception distance is terrain dependent, but for our type of applications, it is about 400 to 800 meters. The wildlife literature is replete with information regarding the use of this type of equipment [6, 7]. Similar radio tracking techniques have been used by law enforcement personnel to monitor suspects engaged in criminal activities [8], but this ongoing study apparently represents the first use of these radio techniques in forensic science.

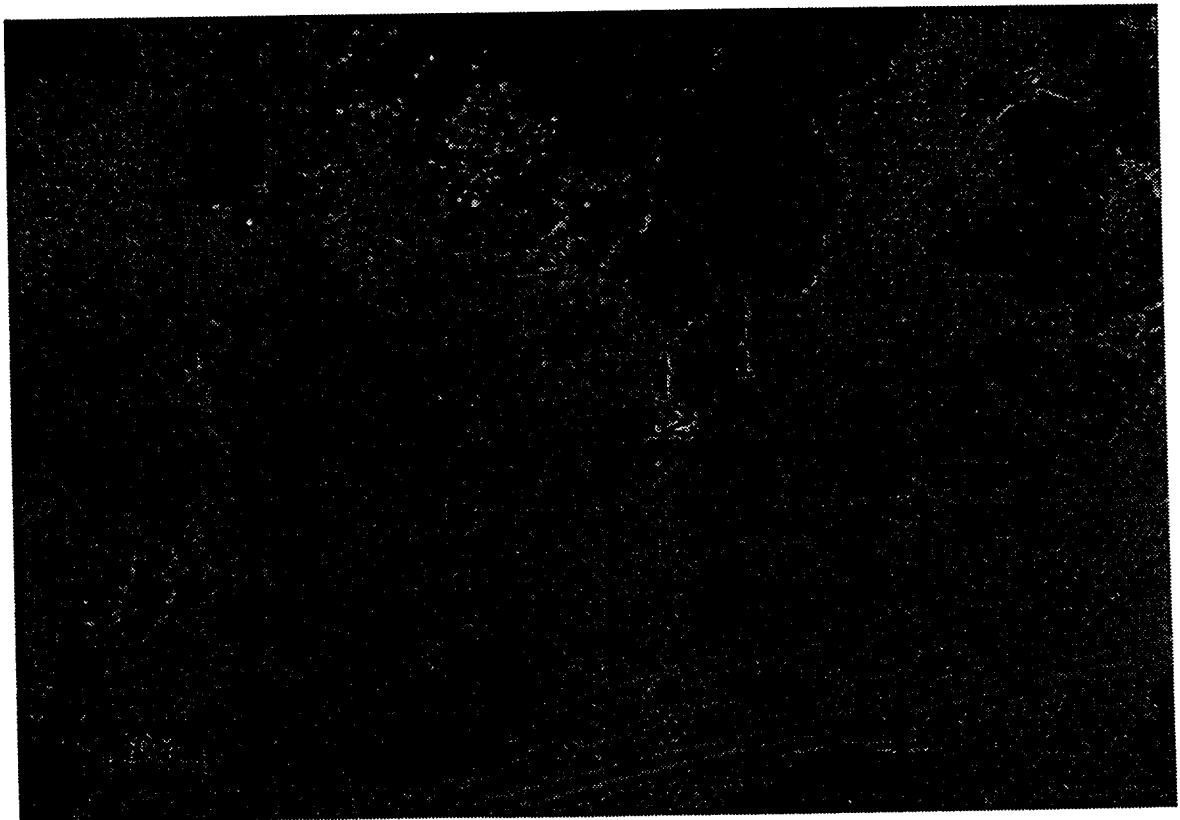
## RESULTS

### Site #12:

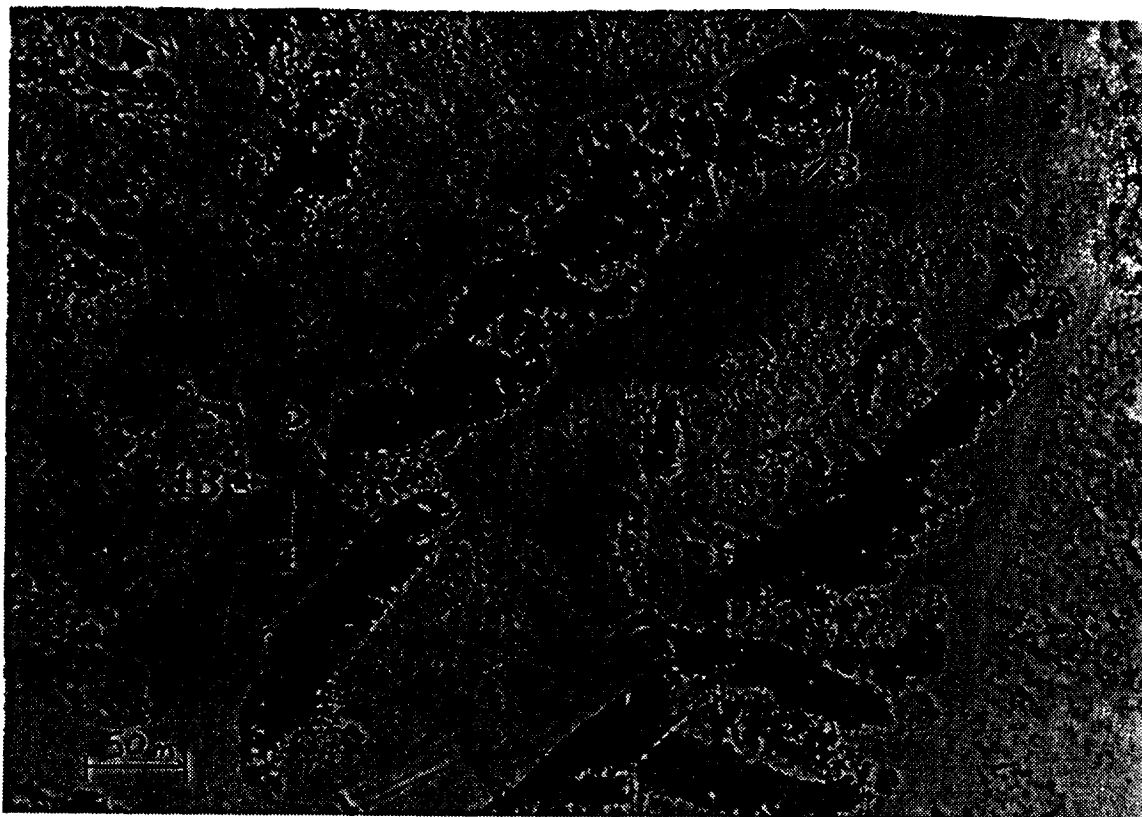
On June 5, 1994, a 22.5 Kg pig was buried on an east facing slope in a shallow grave, having a bottom depth of 25.0 cm, and covered with dirt and brush. Prior to burial a single radio transmitter was attached to the left tibia. By June 13, 1994, the grave had been scavenged and the tibia moved to an area about 10 meters north of the grave; the tibia was still articulated with the femur (fig. 1, #1). On June 14, 1994, the tibia was found on the surface approximately 15 meters northwest of its previous location and was no longer articulated with the femur (fig. 1, #2). The tibia was fully skeletonized and remained in that location until it was retrieved on September 15, 1994.

### Site #13:

On July 12, 1994, a 27.0 Kg pig was placed in a drainage ditch next to a service road within the P.I.G. site. A plastic bag was wrapped around its head and a single radio transmitter affixed to the left tibia. By July 20, 1994, the pig had been scavenged and the tibia was located 9 meters southeast of the original site (fig. 2, #1). On July 24, 1994, the tibia was found in scrub oak bushes about 35 meters southeast of the deposition site, partially covered by fallen leaves, and void of most of the soft tissue (fig. 2, 2). The transmitter remained securely fastened around the shaft of the tibia. On July 30, 1994, the tibia was



**Figure 1.** Description: Aerial photograph of site number 12 showing the distribution of the left tibia (Aerial photograph courtesy of Microflight Technologies; Littleton, CO. USA.)  
12 = Burial Site  
1 = Location of tibia on June 13, 1994  
2 = Location of tibia on June 14, 1994



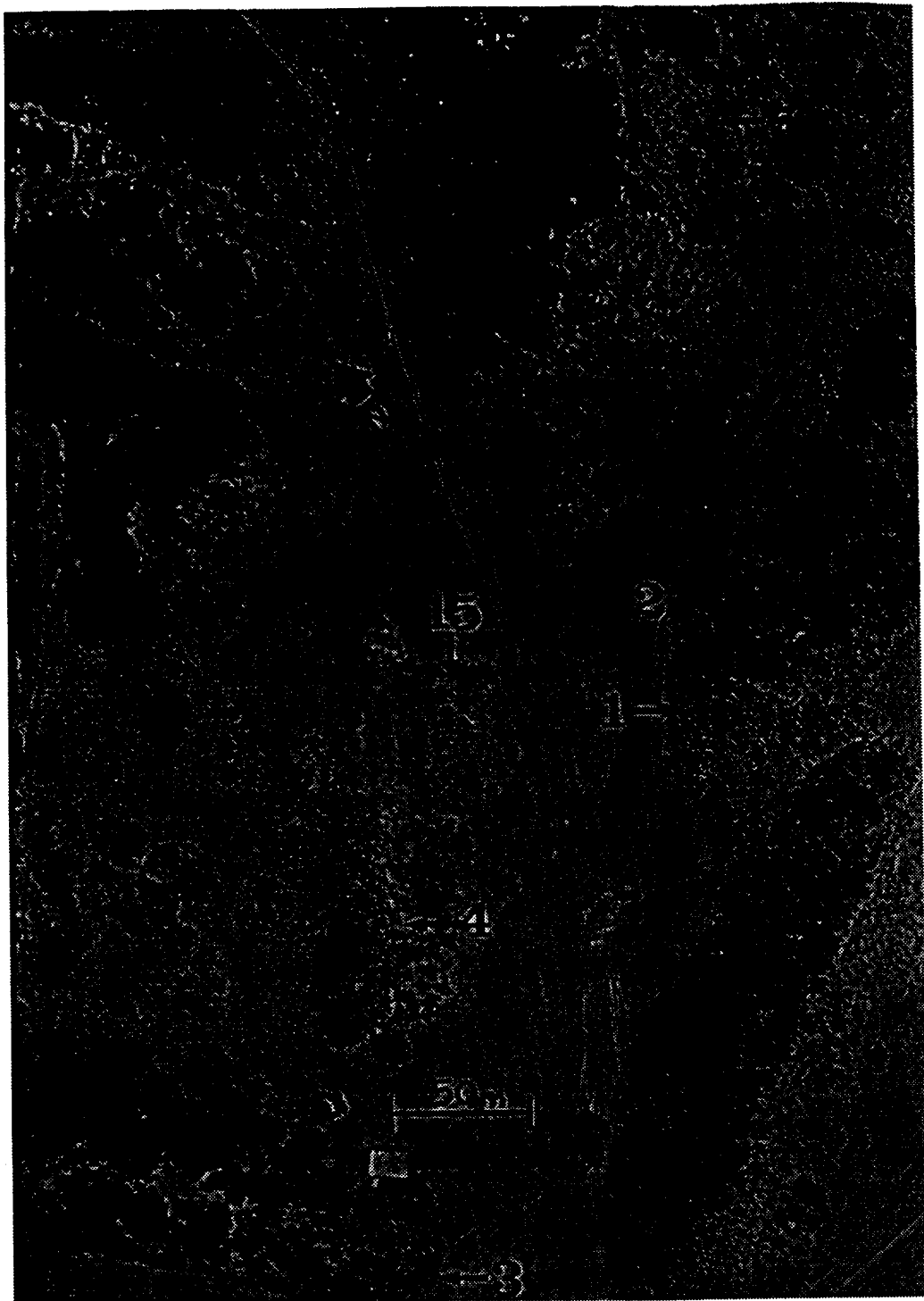
**Figure 2.** Description: Aerial photograph of site number 13 showing the distribution of the left tibia (Aerial photograph courtesy of Rocky Mountain Aerial Surveys Inc.; Englewood, CO. USA).

- 13 = Deposition site
- 1 = Location of tibia on July 20, 1994
- 2 = Location of tibia on July 24, 1994
- 3 = Location of tibia on July 30, 1994

relocated approximately 420 meters (0.27 miles) east of the original site in dense scrub oak (fig. 2, #3). In order to test the longevity of the transmitter battery it was decided to leave the transmitter undisturbed at that location. On September 20, 1994 the transmitter was retrieved but it was no longer attached to the tibia. Severe gnawing and chewing damage was found on the transmitter and collar suggesting that heavy modification must have occurred to the bone. A thorough search of the brush was conducted, but the tibia was never located.

#### **Site #15:**

On October 30, 1994 a 13.0 Kg pig was placed in a shallow grave having a bottom depth of 27 cm. Transmitters were attached to the frontal bone, left os coxa, left femur, and left tibia for a total of four active radios. In order to attach the collars to the frontal bone and os coxa, two 1/4 inch holes were drilled through the bones creating a loophole for the collar. On November 18, 1994 the grave was discovered scavenged. The tibia was located approximately 127 meters southeast of the grave, buried in the scrub oak on a snow covered, north facing slope (fig. 3, #2). The transmitter attached to the femur was located November 23, 1994, on a snow covered slope approximately 100 meters southeast of the grave (fig. 3, #1). The transmitter was severely damaged by carnivore chewing and no bone fragments could be located because of snow cover. Due to the damage, the transmitter



**Figure 3.** Description: Aerial photograph of site number 15 showing the distribution of skeletal elements fitted with radio transmitters (Aerial photograph courtesy of Rocky Mountain Aerial Surveys Inc.; Englewood, CO. USA).

- 15 = Burial Site
- 1 = Location of tibia on November 18, 1994
- 2 = Location of femur on November 23, 1994
- 3 = Location of cranium on November 18, 1994
- 4 = Location of cranium on November 30, 1994
- 5 = Location of os coxa on November 18, 1994
- 6 = Location of os coxa on November 30, 1994

was removed from the site and deactivated. The cranium was found buried at the base of a tree, approximately 240 meters southwest of the grave (fig. 3, #3). The os coxa was located about 250 meters east of the grave (fig. 3, #5), buried about 4 cm below ground level, with most soft tissue still in good condition.

On November 30, 1994, the two remaining transmitters on the os coxa and cranium were relocated at new sites. The cranium was about 140 meters southwest of the grave site (fig. 3, #4), with its transmitter on the surface. The frontal bone was not present, however, two maxillary fragments were adjacent to the transmitter. The transmitter associated with the os coxa was found on the surface approximately 64 meters west of its previous position (fig. 3, #6). No bone fragments were found, but, due to heavy underbrush an exhaustive search of the area was not conducted. The tibia (fig. 3, #2) was collected on November 28, 1995. This transmitter was left buried for one year to test its performance under varying weather conditions.

## DISCUSSION

Although only three pigs have been instrumented with transmitters, initial results are promising. The success in the recovery of instrumented skeletal remains at the P.I.G. site, as well as the information gained about the taphonomy, is a significant advancement compared to recovery efforts of pigs not fitted with radio transmitters. Tracks and scat discovered around the three sites indicate that the primary scavenger were coyotes, however, secondary scavenging and some of the movements of the body parts may have been caused by other animals. One significant scavenging activity observed during this study was the reburial of the pig remains at sites distant from the original grave. This reburial, in effect, creates multiple clandestine graves thus making recovery efforts much more complex. Obviously, any animal behavior that scatters the remains over a large area will prove to be a formidable obstacle for law enforcement agencies. Experienced personnel, knowledgeable about taphonomic processes, are invaluable in such cases. Further radio telemetry studies are planned to enhance our understanding of how scavengers can disperse skeletal remains.

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